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THE FRENCH ATLANTIC LITTORAL

AND THE MASSIF ARMORICAIN

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ECOLE PRATIQUE DES HAUTES ETUDES

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ORIGINAL CONTAINS COLOR ILLUSTRATIONS

March 1976

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12. Sponsoring Agency Name and Address CENTRE NATIONAL D'ETUDES SPATIALES 129, rue de l'Université 75007 - PARIS. France	13. Key Words (Selected by Principal Investigator) Tidal marsh; littoral transport, estuary ; beaches ; wetlands ; computer analysis
14. Supplementary Notes	Part 2 : faulting ; ore deposits.

Prepared in cooperation with J. M. MONGET and J.-Y. SCANVIC

15. Abstract :

This second progress report gives initial results on Landsat - 2 data received in the corresponding period. During this period 22 scenes were received and evaluated. Most of them covered the summer of 1975 and cloud cover was on the whole quite low.

Two more scenes have been ordered in CCT Format :

- Loire Estuary
- Islands of the bay of Biscay.

These have been chosen to complete or extend time-series covering significant test areas.

Part 2 of the report covers research done by the B.R.G.M.

1 - INTRODUCTION

This report covers the first quarter of 1976 during which a number of significant new techniques has been made operational using, LANDSAT-1 data.

Over the same period, LANDSAT-2 data has been received and reformated to our databank standard (assembly of 4 strips to single scene recording) on direct-access units.

Interpretation, classification and mapping of LANDSAT-2 data has been initiated, singly or in connection with LANDSAT-A data, with emphasis on coastal areas, extending seaward to the extent of coastal sediment transport and landward into saltmarshes, dunes and polders.

2 - TECHNIQUES

2-1 - Photographic : 70 mm B/W negatives were examined as received, and after enlargment to 1/1000 000 th scale. Particular attention was directed to scenes suitable for ordering in CCT format.

2-2-1 : 4 strip records were copied on disk using 3240 pixel/line format to facilitate data processing, especially in areas bisected by strip borders.

2-2-2 : Various improvements were carried out on our supervised automatic mapping procedures (using IBM 360 and Benson Offline Plotting System) to save program execution time.

2-2-3 : Time sharing (Tektronix 4013 output linked to IBM 360) : further development of the FRACAM package have no made this unsupervised interactive classification system fully operationnal.

2-2-4 - The CLAMS unsupervised automatic classification program provides graphic output on Calcomp microfilm.

2-2-5 : A test run for evaluation of the stand-alone GE-IMAGE-100 supervised system was conducted by Dr. J.M. MONGET at the NASA-JSC remote sensing facility. Sample color displays one shown in Fig. 2.2.5.1 and 2.2.5.2. Special attention was given to the software/hardware trade-offs.

2-2-6 : A smoothing technique is being tested based on using each pixel in the mapped output from programs (2.2.2. and 2.2.3) as the centre of a rectangular or square matrix and replacing this pixel with the modal signature found in the surrounding matrix.

3 - ACCOMPLISHMENTS

3-1 - Ground truth : for LANDSAT-2 data, we have continued to draft maps of coastal areas showing directions of currents and tide heights (following pages). Times given are T.U. (Fig. 3.1.1. to 3.1.6).

3-2 - Mapping of offshore currents (Fig. 3-2)

The map of the Island of Jersey and surrounding marine approaches was obtained from LANDSAT-1 imagery by automatic mapping techniques described presiously. Green areas are land, black and brown show clouds and cloud

shadow (a major interpretation hindrance). Blue and yellow show waters of increasing turbidity (symbols 1 through 4) and in particular the strange shapes found in the mixing area of the turbidity front. No explanation has been found for this phenomenon, actually under investigation, but it is a typical example of scientific observation which could not be obtained by any other means, and for which the scale if not the spectra of MSS imagery is idealty suited.

3-3 - Application of techniques developped with LANDSAT-1 data to the fromentine test-site, chosen for it's extensive homogenoux landscape.

Fig. 3.3.1 is an example of graphic output after supervised classification water was separated using MSS band 7 and then differentiated by turbidity detected in band 5 (symbols 1-6).

Shoreline sediment has been classified according to type : sand (symbol 8) and mudflats (symbols 9 through 12).

For the mudflats, varying degrees of wetness (decreasing from 9 to 12) have been identified. In the north-eastern corner, freshly plonghed polders show up as sandy areas. Finally symbols 13 to 18 show various types of vegetation, particularly 13 and 14 (psammophytes more or less covering dunes), maritime pine forests (15), and cultivated marshes (16).

The following illustrations are an example of data smoothing described in 2.2.6. From the original 1/80 000 scale classification, which used data from to LANDSAT-1 scenes, the FRALISSE program devises Fig. 3.3.3. (smoothing by retraining modal values in a 3 x 3 matrix round each pixel) and, further Fig. 3.3.4 where a 5 x 5 matrix was used.

Here again, darkenning shades of blue show water of decreasing turbidity (1 through 5) and brown and yellow are mud and sand. For these last two types, data from 2 scenes have been used as an 8 band classifyuing instrument. The lighter symbols (5,7) show areas absove tide levels at both dates and the darker ones (6,8) are areas incovered on Sept 27, 1972 but covered on March 8, 1973.

Finally Fig. 3.3.5 is an example of 3 scene diachronic classification, using 12 MSS channels and whereas water was drawn from a single scene, it is now possible to identify 3 tide levels in sandy and mudflat areas and to drawn more accurate distinctions between 3 types of vegetation.

All these maps have been drawn up over a fairly long period due to data delivery, research and publication delays. But we are presently applying similar techniques to LANDSAT-2 data, particularly a scene covering the Fromentine test-site and preliminary results show that a 3 year span is sufficient to allow efficient monitoring of coasteline dynamics

Fig. 2.2.5.1

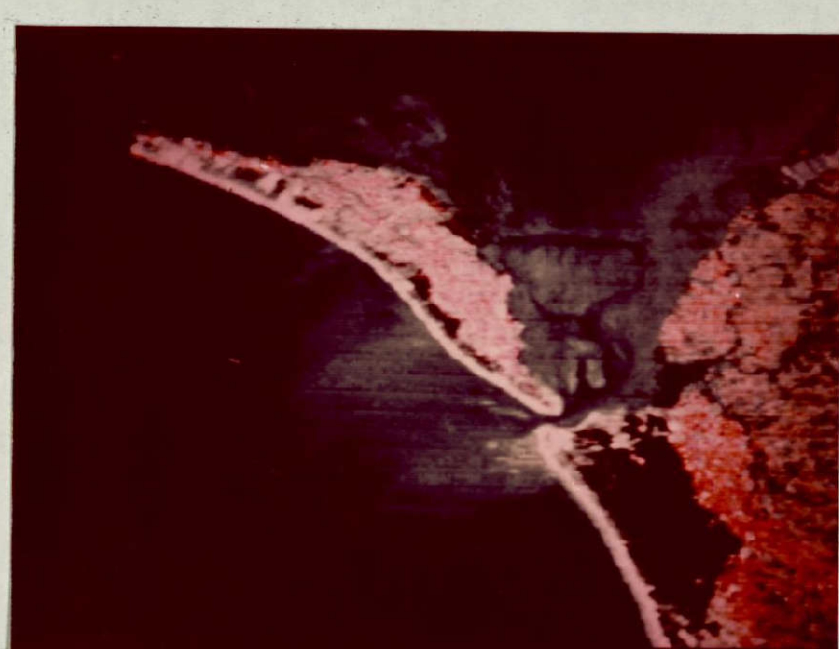
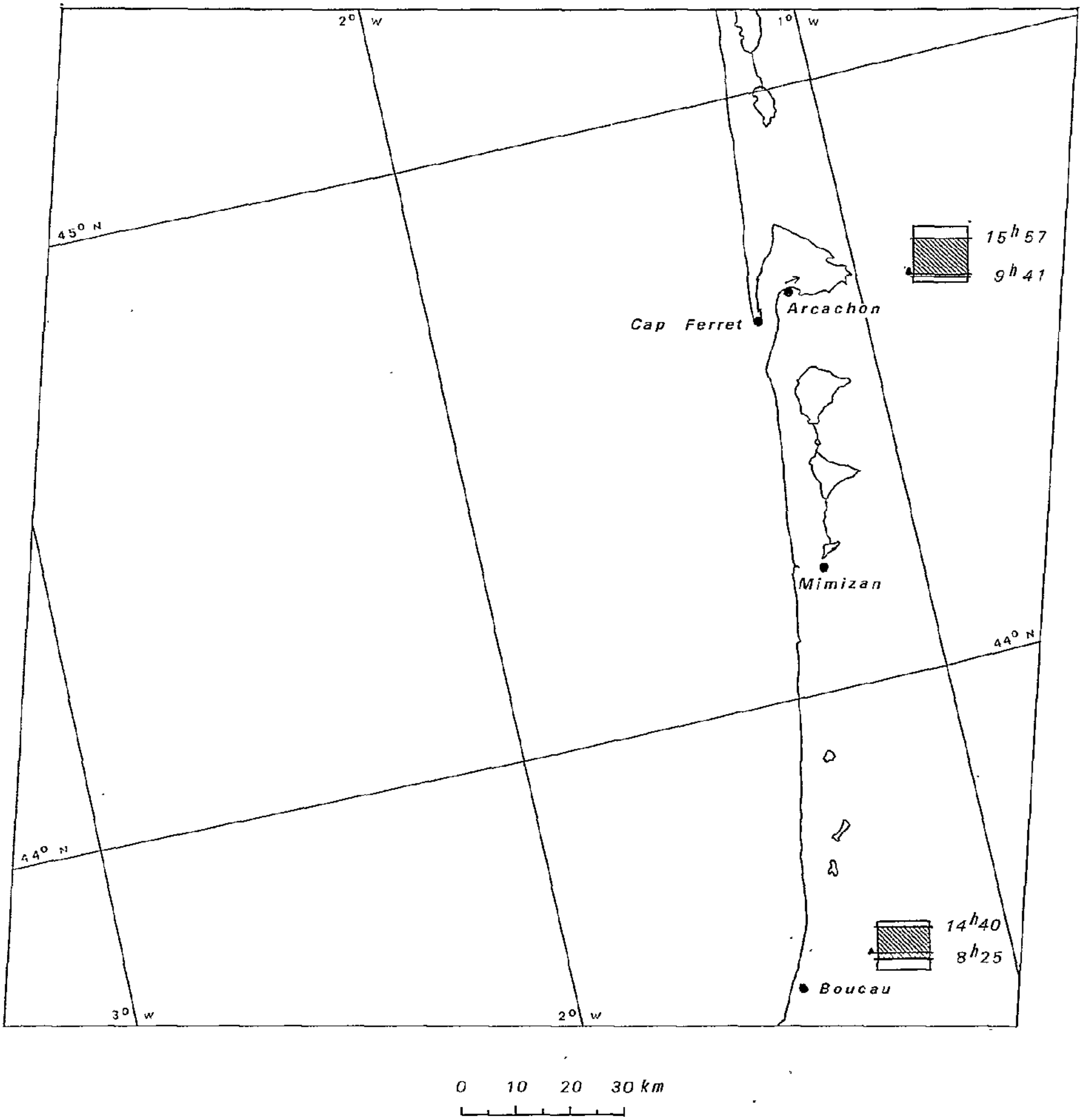


Fig. 2.2.5.2

GE IMAGE 100 colour output for the Fromentine test site.

NASA - LANDSAT 2 2151 10135



Tidal currents (1 cm = 1 m / s)

Tidal range and water level (2 mm = 1 m)

June 22, 1975

→ SHOM

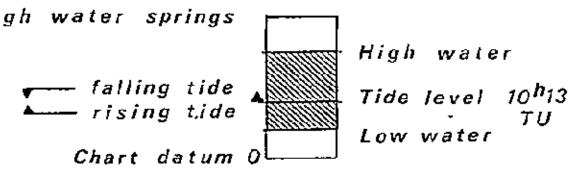


Fig. 3.1.1. : Hydrological ground - truth data.

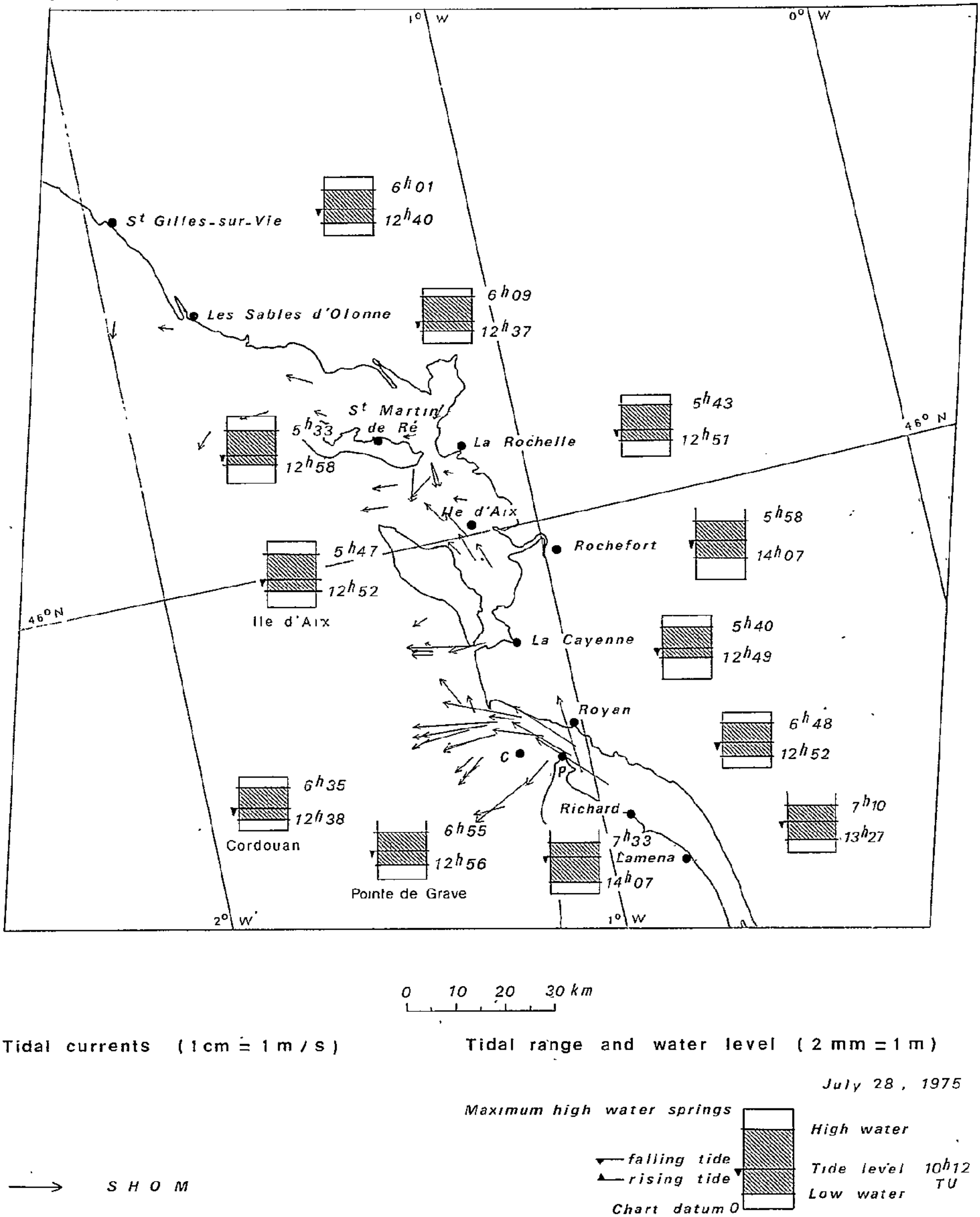
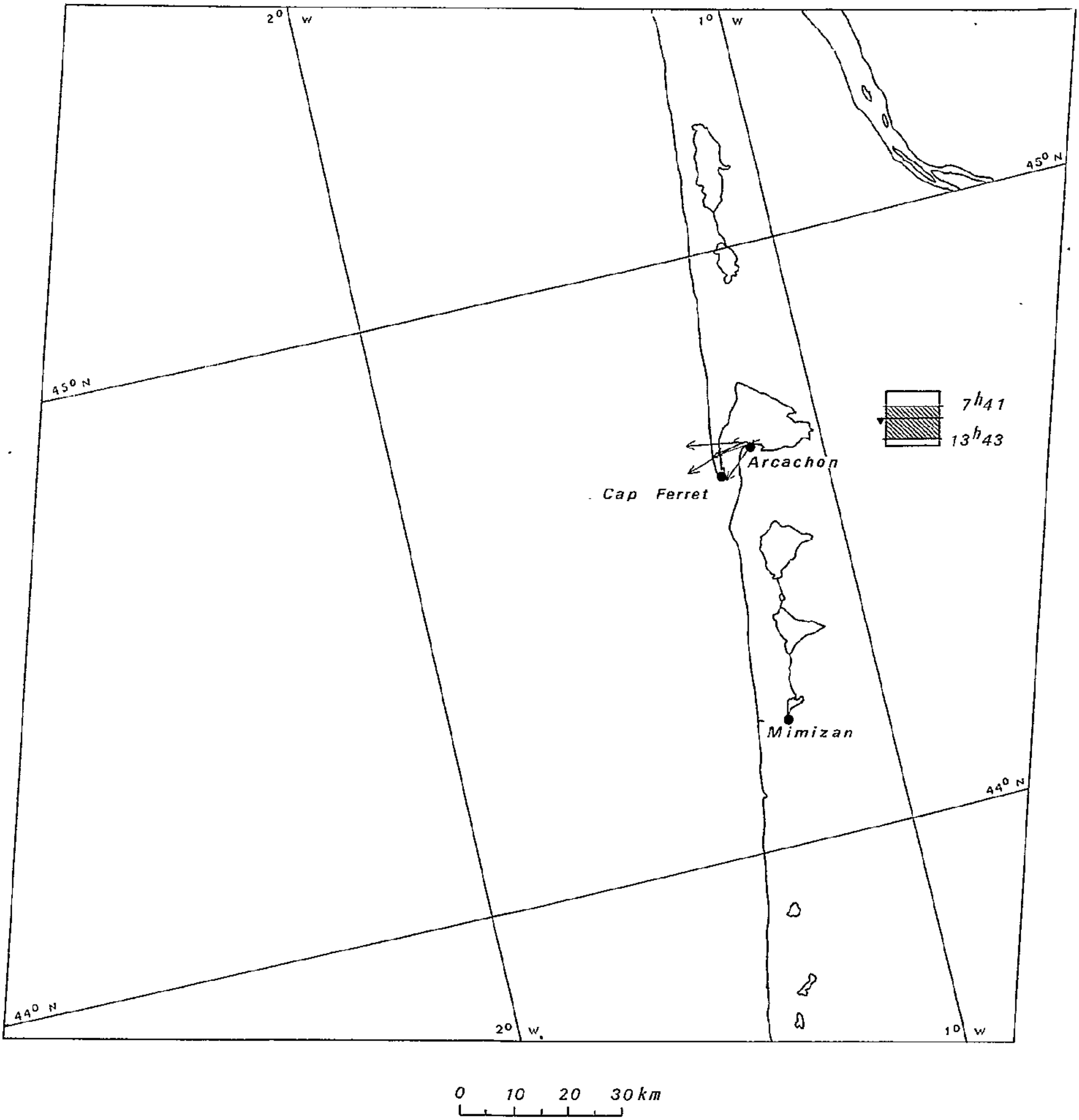


Fig. 3.1.2. : Hydrological ground - truth data.

NASA - LANDSAT 2 2187 10132



Tidal currents (1 cm = 1 m/s)

Tidal range and water level (2 mm = 1 m)

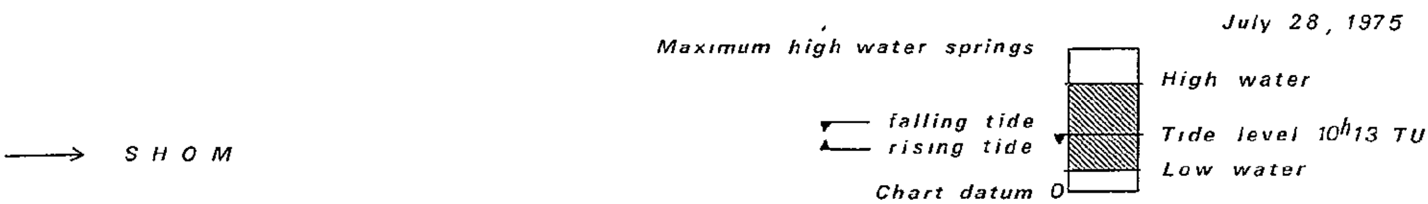


Fig. 3.1.3. : Hydrological ground - truth data.

NASA - LANDSAT 2 2188 10181

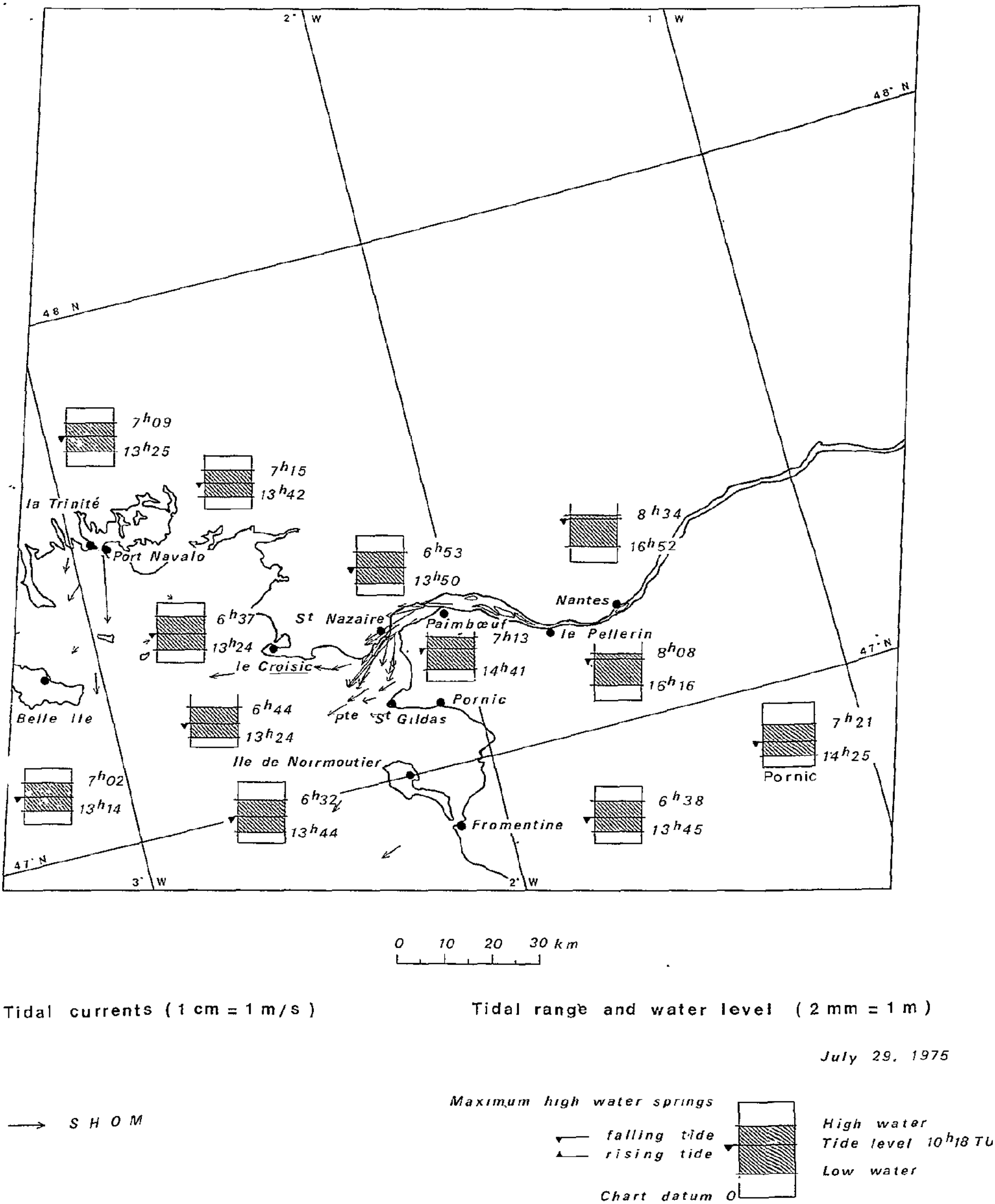


Fig. 3.1.4. : Hydrological ground - truth data.

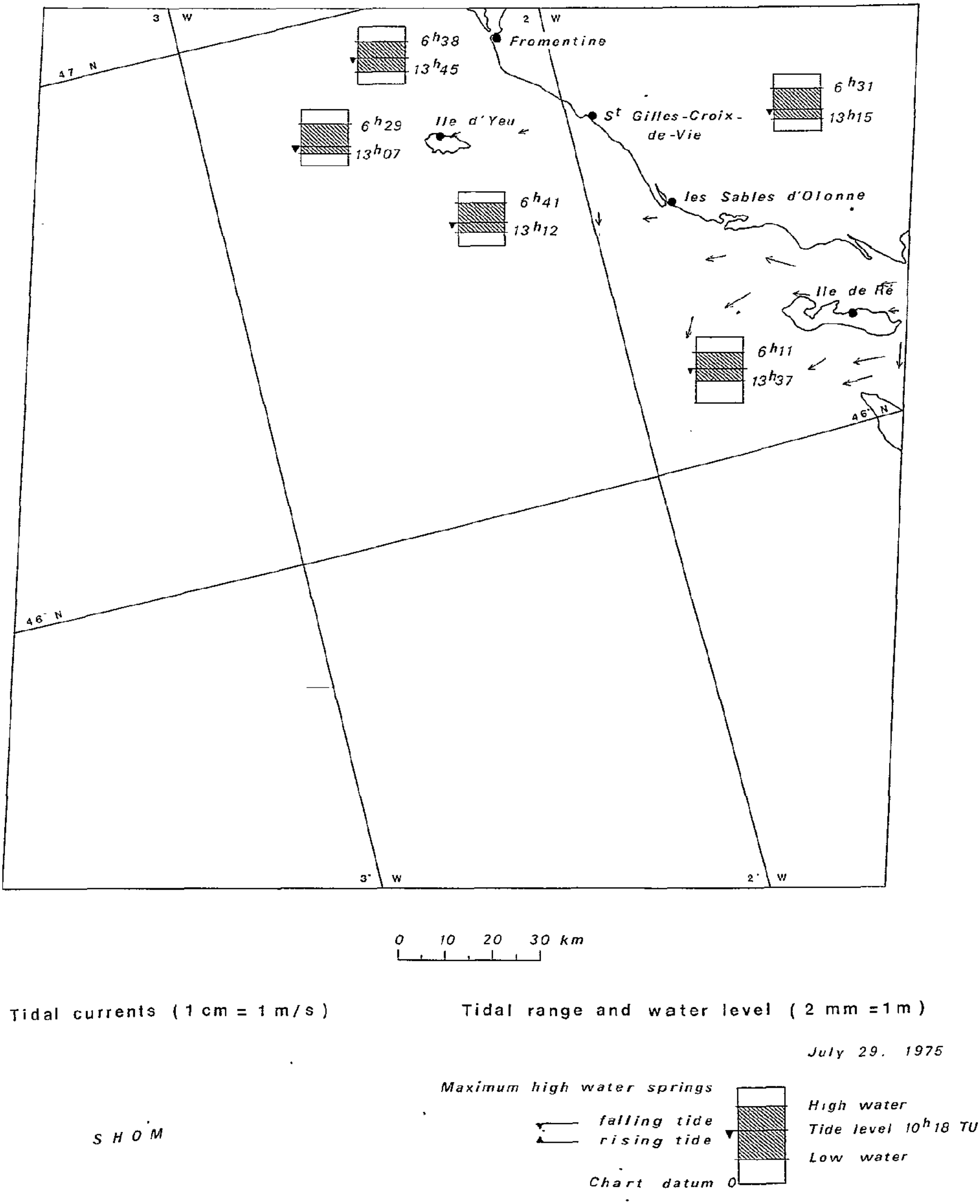


Fig. 3.1.5. : Hydrological ground - truth data.

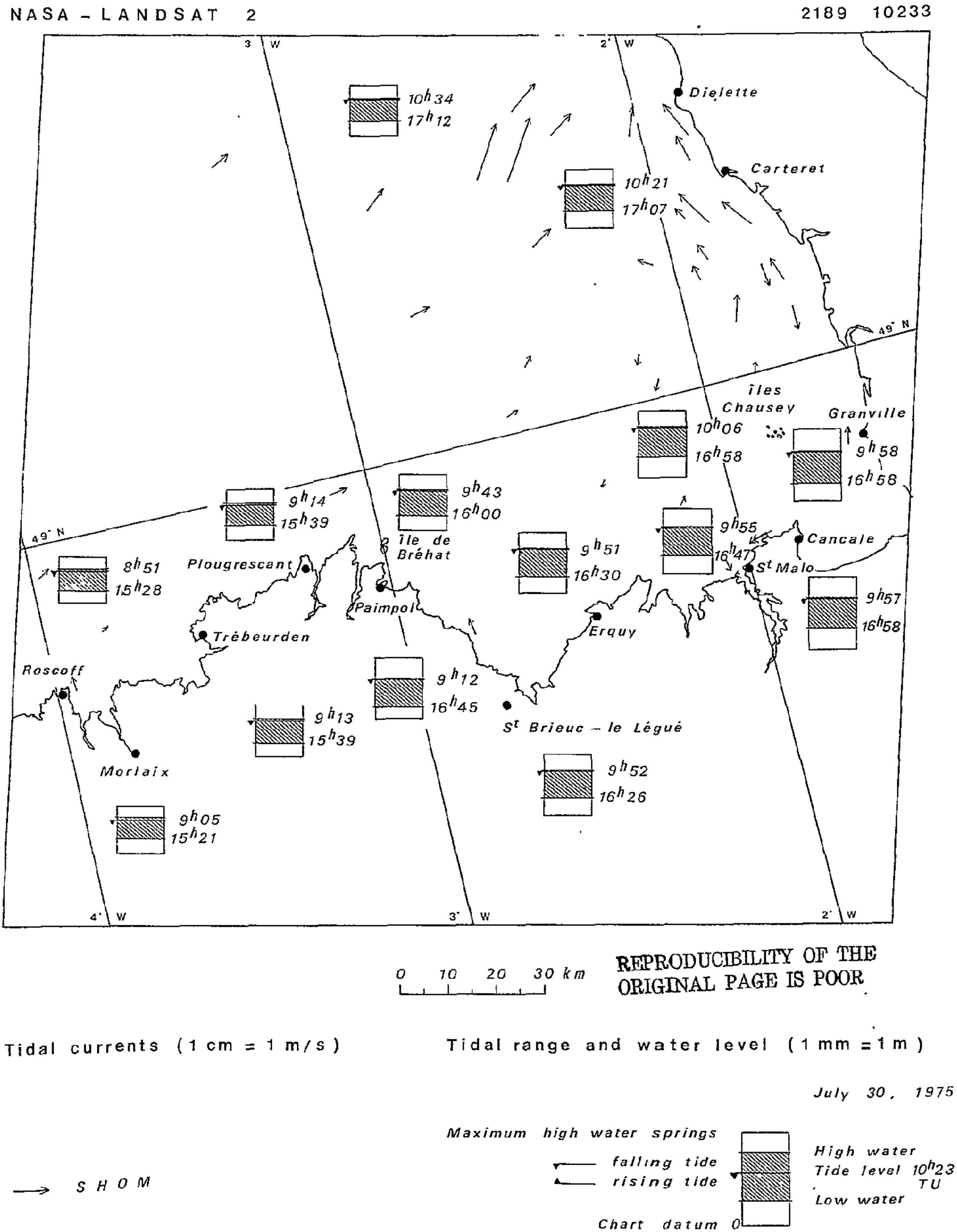


Fig. 3.1.6. : Hydrological ground - truth data.

FORMES DE TURBIDITE DANS LE GOLFE NORMAND BRETON

DONNEES ERTS-1 DU 8 MARS 1973

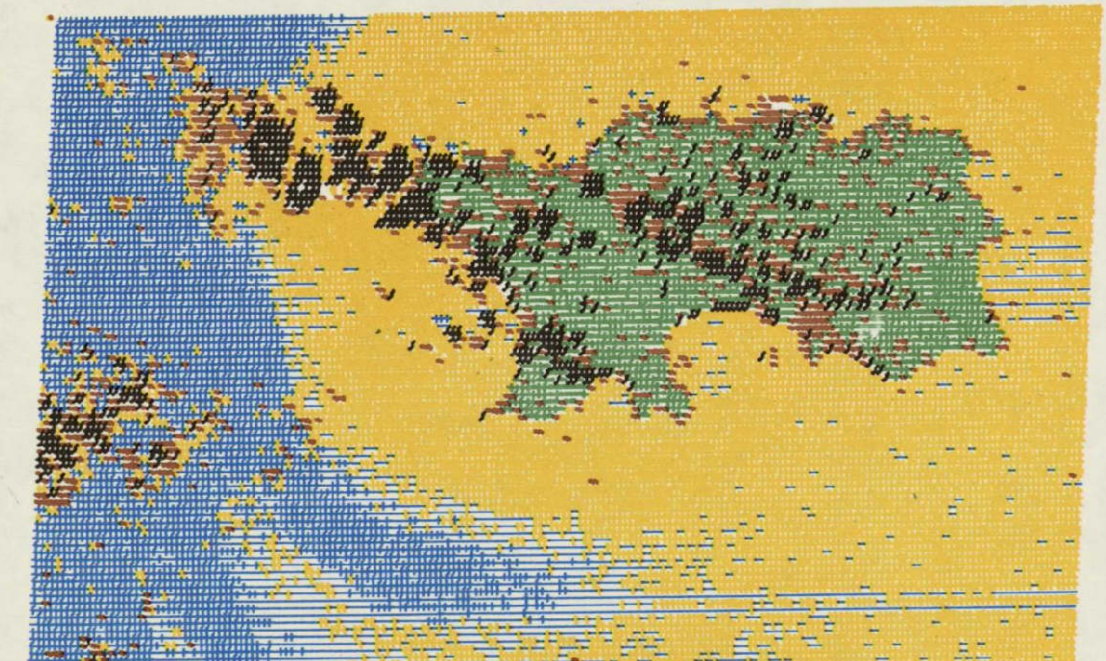
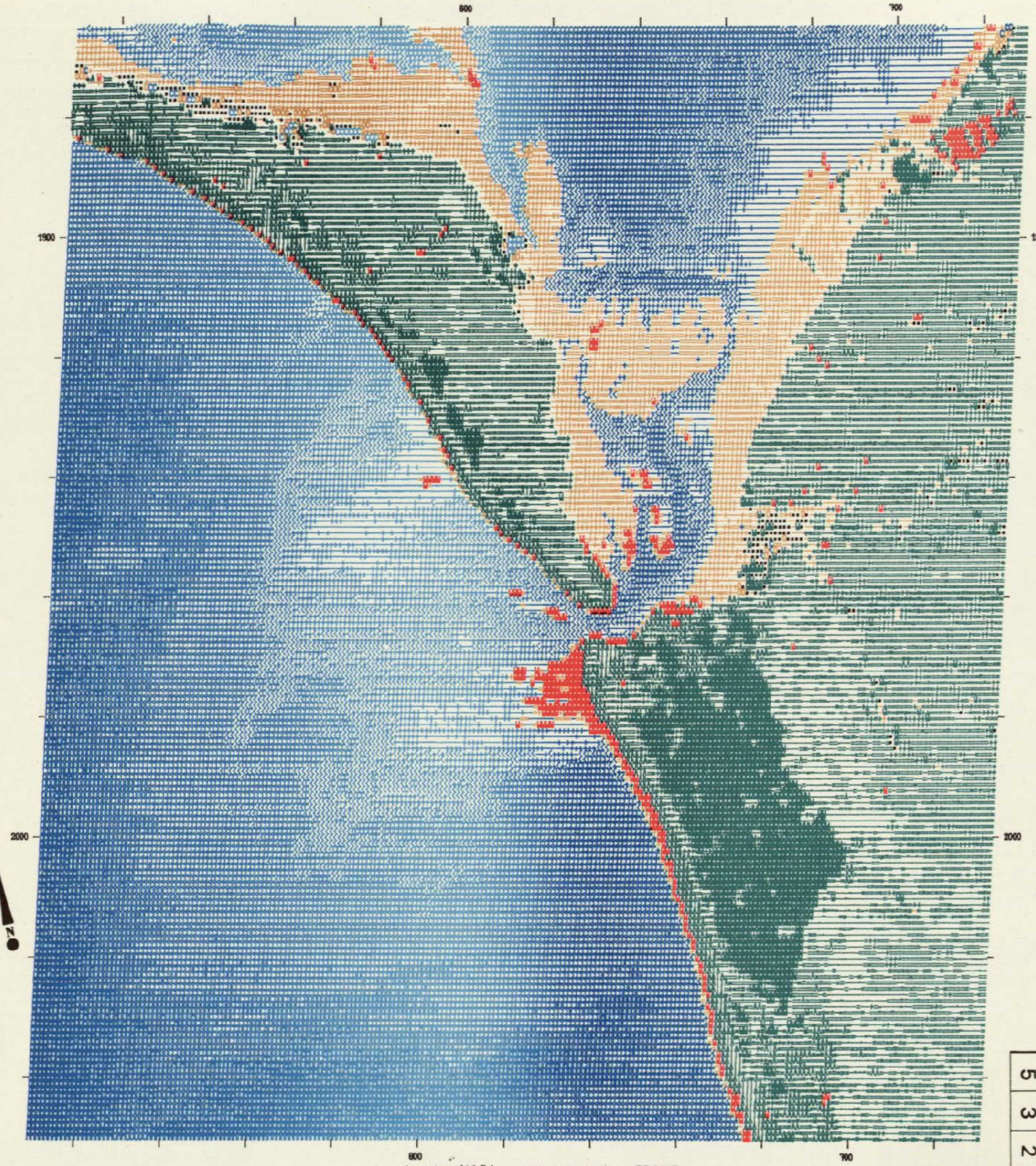


Fig. 3.2. : Sediment transport round the Island of Jersey.

CARTOGRAPHIE AUTOMATIQUE DES DONNÉES DE LANDSAT 1

74-6
1



donnees NASA – carte automatique FRALIT

NOMBRE DE CARACTÈRES	SURFACE EN KM²	NUMÉRO DE RÉFÉRENCE	NOMBRE DE CARACTÈRES	SURFACE EN KM²	NUMÉRO DE RÉFÉRENCE	NOMBRE DE CARACTÈRES	SURFACE EN KM²	NUMÉRO DE RÉFÉRENCE
1958	8.83	1	225	1.01	7	104	0.47	13
3991	17.99	2	480	2.16	8	1117	5.04	14
10245	46.18	3	976	4.40	9	1838	8.29	15
2945	13.28	4	1697	7.65	10	1683	7.59	16
2940	13.25	5	503	2.27	11	7597	34.25	17
1366	6.16	6	77	0.35	12	1364	6.15	18

P 5 3 2 0 6 1 0 0 0

F FRANCE	NASA-LANDSAT 1 MSS 5 et 7 image n° 1066-10294-5 et 7	27-9-72 10 h 29	1 : 75 000 λ 0,6-0,7 µm λ 0,8-1,1 µm	1 : 50 000 IGNF feuilles NOIRMOUTIER 24 X BARBÂTRE et CHALLANS 25 X et XI	74-6 1

1

Fig. 3.3.1. : The Fromentine test site : scale = 1/75 000.

CARTE DIACHRONIQUE DU GOULET DE FROMENTINE D'APRES LES DONNEES DE LANDSAT-1
ATLAS INFOGRAPHIQUE DU LITTORAL FRANCAIS (PROGRAMME FRALIT) CONVENTION 75/CNES/222

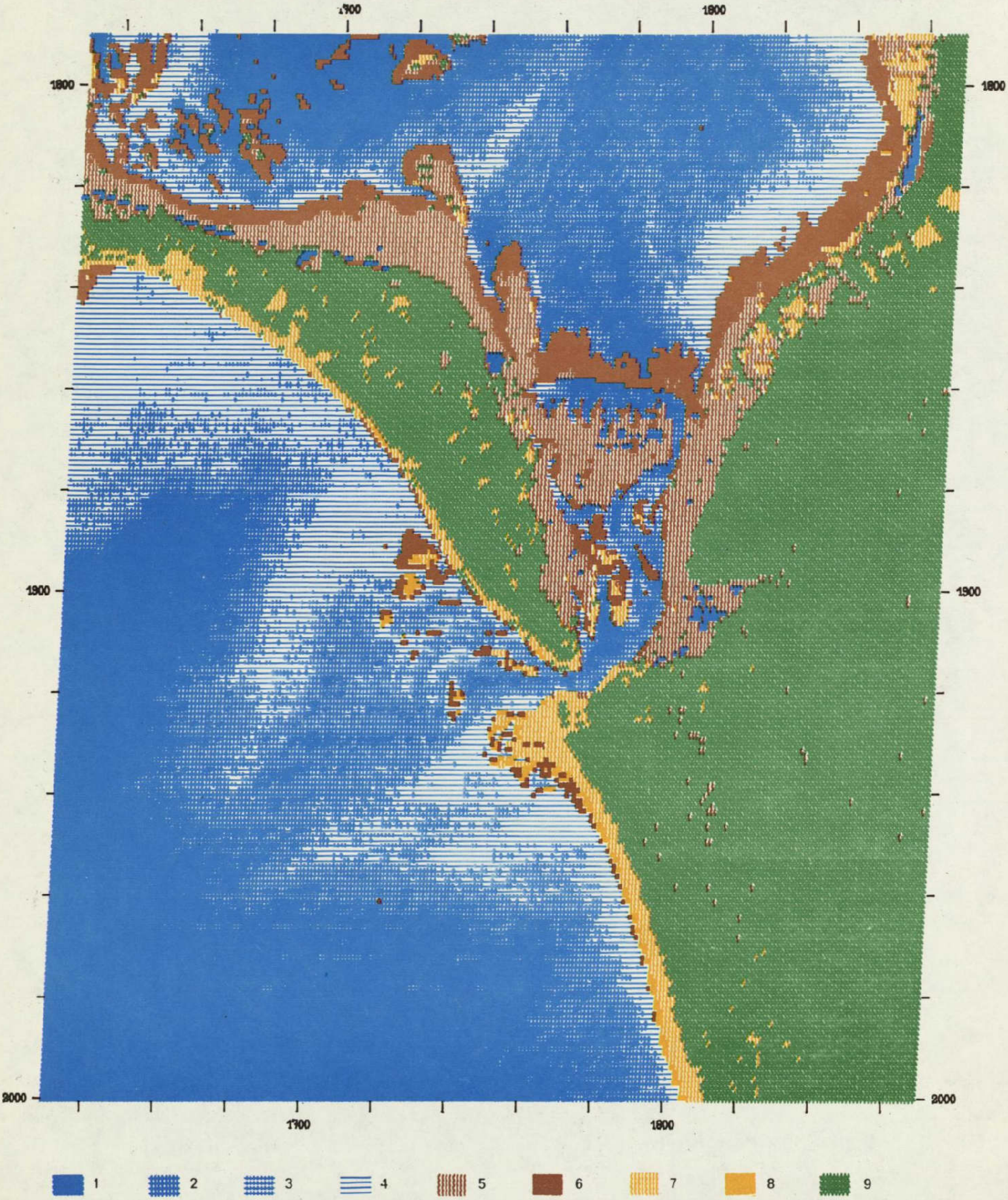
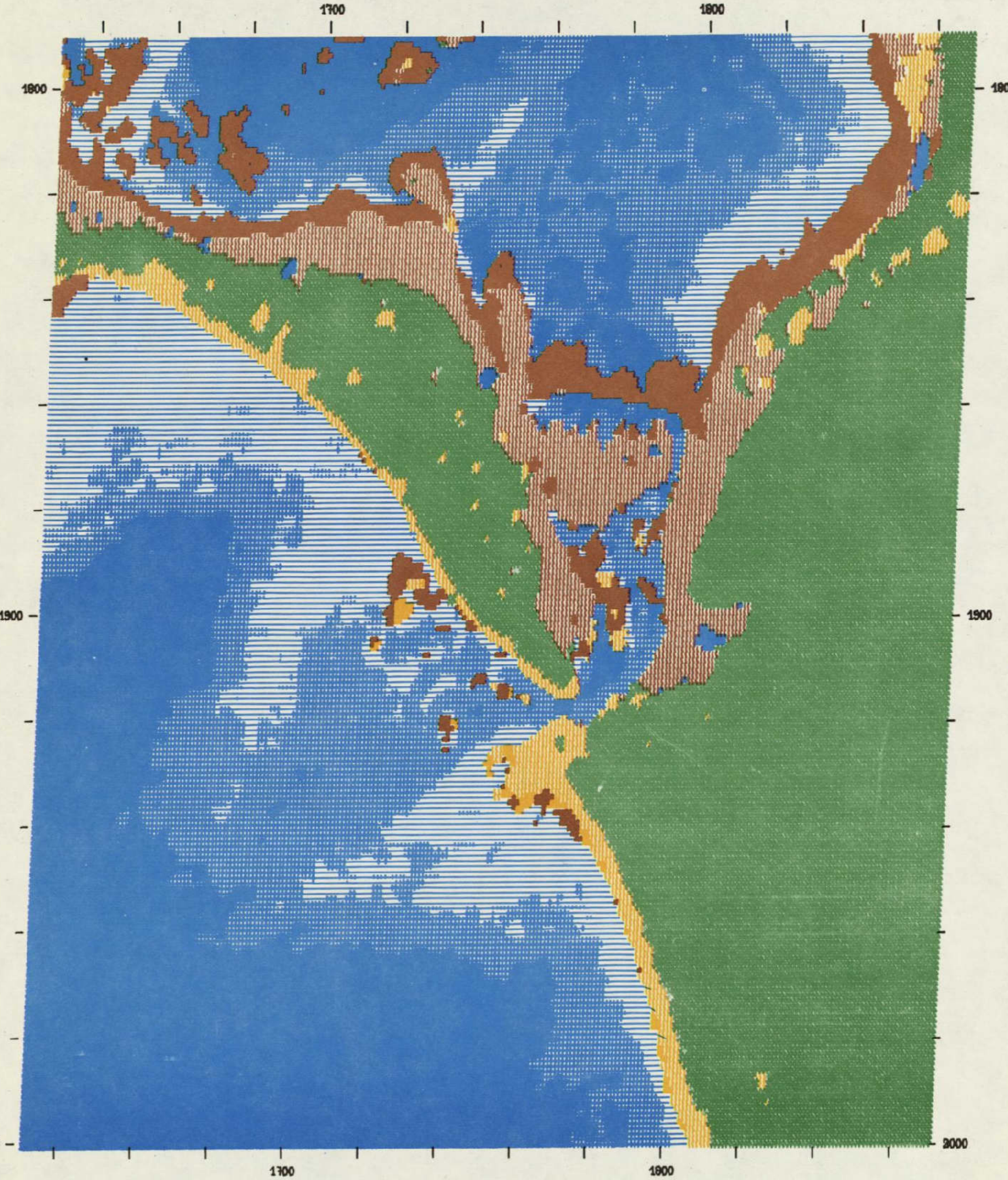


Fig. 3.3.2. : The Fromentine test site : scale = 1/80 000.

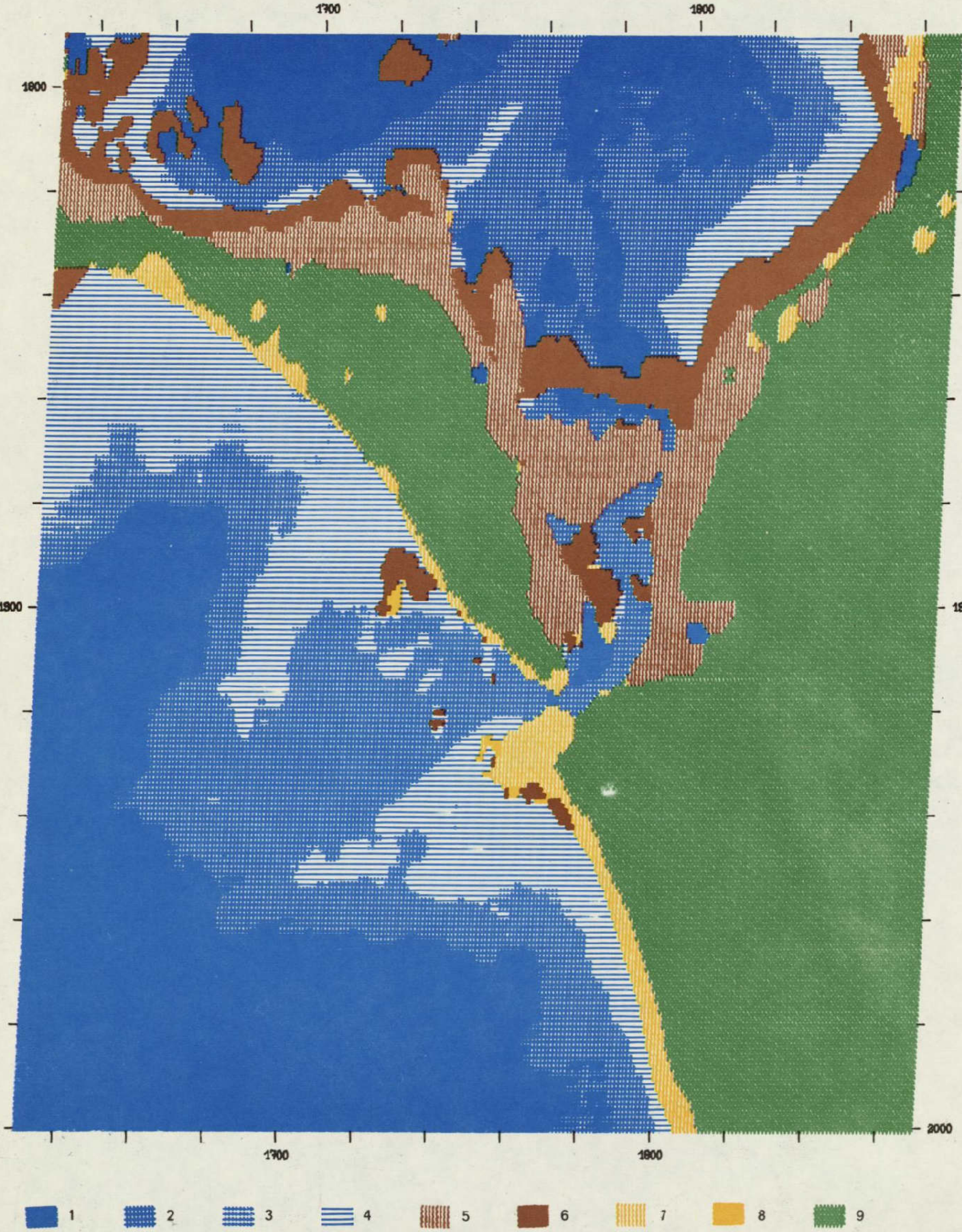
CARTE DIACHRONIQUE LISSEE DU GOULET DE FROMENTINE D'APRES LES DONNEES DE LANDSAT-1
ATLAS INFOGRAPHIQUE DU LITTORAL FRANCAIS (PROGRAMME FRALIT) CONVENTION 75/CNES/222



ÉCHELLE : 1 : 80 000

Fig. 3.3.3. : The Fromentine test site : scale = 1/80 000, 3 x 3 smoothing.

CARTE DIACHRONIQUE LISSEE DU GOULET DE FROMENTINE D'APRES LES DONNEES DE LANDSAT-1
ATLAS INFOGRAPHIQUE DU LITTORAL FRANCAIS (PROGRAMME FRALIT) CONVENTION 75/CNES/222



ÉCHELLE : 1 : 80000

Fig. 3.3.4. : The Fromentine test site : scale = 1/80 000, 5 x 5 smoothing/

74-6
2

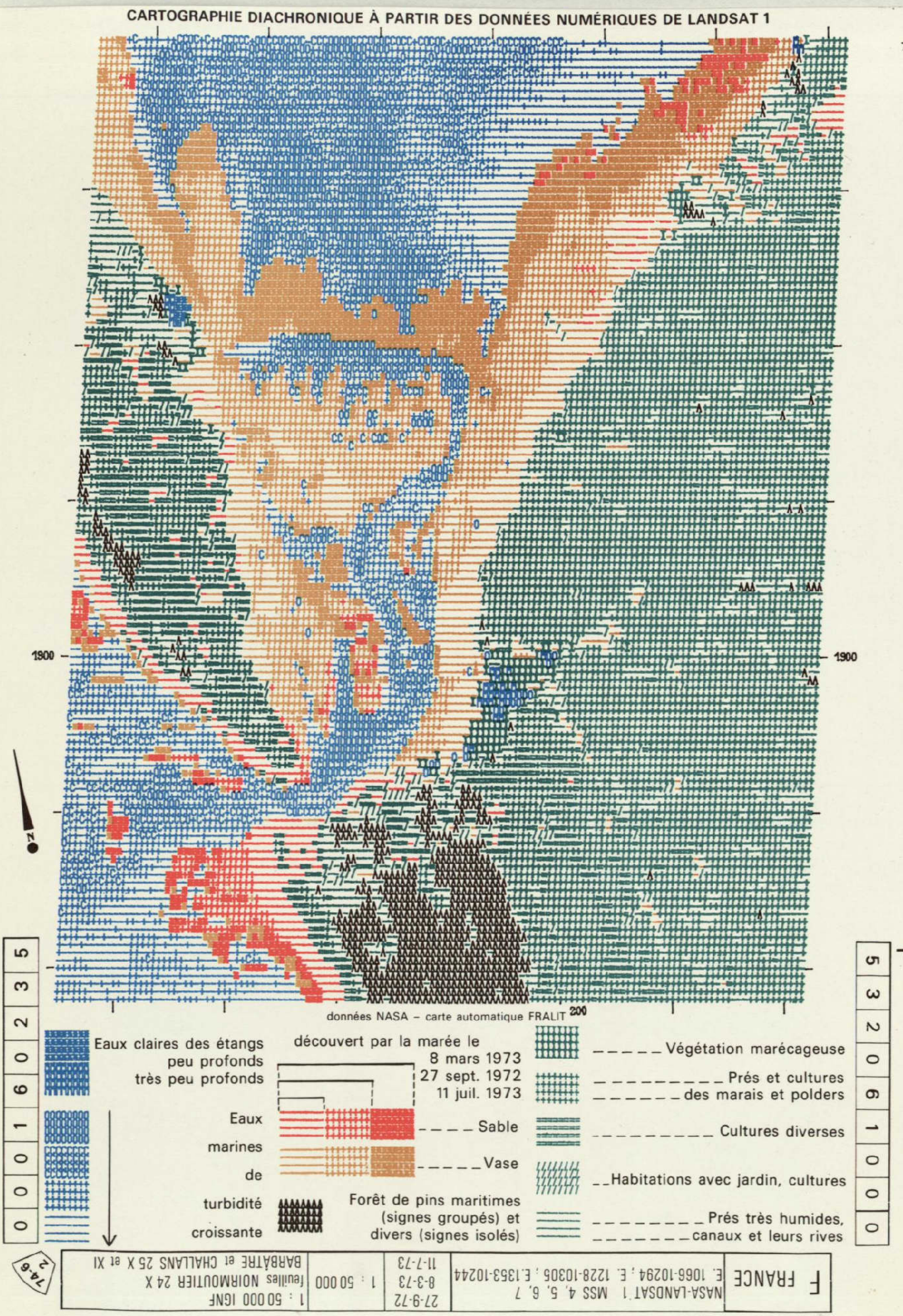


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Fig. 3.3.5. : The Fromentine test site : scale = 1/50 000. 3 scenes diachronic map.

4 - SIGNIFICANT RESULTS

Diachronic use of LANDSAT data time series will in time allow us to study statistically submersion frequencies in tidal areas. This is an essential element of coastal geomorphology and of coastal zone management, bening particularly useful in siting shellfish farms. The maps we are obtaining, at useable scales and simple, user oriented legends should become an essential document for coastal planning agencies.

5 : LIST OF PUBLICATIONS :

- Fernand VERGER : Une cartographie automatique des données de LANDSAT - 1.
  Photo-Interprétation. XIIIè année, 1974, fasc. 6, p. 1-6.

- Fernand VERGER , Gérard JOLY : Cartographie diachronique à partir des données numériques de LANDSAT - 1.
  Photo-Interprétation. XIIIè année, 1974, fasc. 6, p. 7-13.

- Odile GUERIN , Jean-Marie MONGET : Intérêt de la télédétection pour la connaissance du milieu estuarien ; l'exemple de l'estuaire de la Loire.
  Bull. Union Océanogr. de France, 1975, vol. 7, n° 12, p. 47-54, 2 fig.

6 : DATA QUALITY AND DELIVERY.

Since the last report, 22 frames of B/W 70 mm imagery have been received. Despite certain delays we find that data has been reading us more regularly (2 to 3 months after coverage). Despite extensive inland cloud coverage negative quality has been good in coastal areas but too contrasted for photographic interpretation in marine zones.

The five CCTS ordered during the last quarter of 1975 have been received and treatment has begun using techniques described above and previously in connection with LANDSAT - 1 imagery. Delay was reasonable (2 months from order to reception) but one tape (scene no E 2133 - 10125, quality given as G, F, F, G) appears to be unusable since repeated attempts at reading it cause numerous parity errors.

DATE	PRODUCT ID	BLACK AND WHITE PRODUCTS MSS (Quality) 4	5	6	7	CLOUD COVER (%)	TAPE PRODUCT O=ordered ⊕=received	ORBIT NUMBER	CODE OF FRAMES (L = Littoral)
10 April 75	E2 078-10055	F	P	F	F	30		1083	FLANDRES (L)
"	E2 078-10062	F	F	F	F	40		"	PICARDIE (L)
"	E2 078-10064	F	G	G	G	70		"	BEAUCE
"	E2 078-10071	G	G	G	G	60		"	ANJOU
"	E2 078-10073	G	G	G	G	60		"	CHARENTE-GIRONDE
"	E2 078-10080	G	G	G	F	50		"	LANDES (L)
"	E2 078-10082	G	G	F	G	60		"	GOLFE GASCOGNE (L)
3 June 75	E2 132-10070	P	P	P	P	80		1836	ANJOU-VENDEE
"	E2 132-10073	G	G	G	G	60		"	GIRONDE
"	E2 132-10075	F	G	G	F	70		"	LANDES (L)
"	E2 132-10082	F	G	G	G	60		"	PYRENEES
4 June 75	E2 133-10113	G	P	F	G	40		1850	ARTOIS (L)
"	E2 133-10120	F	F	F	G	30		"	BAIE DE SEINE (L)
"	E2 133-10122	G	P	G	G	60		"	BAIE DE SEINE (L)
"	E2 133-10125	G	F	G	G	50		"	VENDEE (L)
"	E2 133-10131	G	F	F	G	50	⊕	"	GIRONDE (L)
"	E2 133-10134	F	P	G	G	40	⊕	"	LANDES (L)
6 June 75	E2 135-10233	F	P	P	F	20		1878	JERSEY-COTENTIN (L)
"	E2 135-10235	F	F	G	F	30	⊕	"	BAIE ST MICHEL (L)
"	E2 135-10242	F	F	G	F	60		"	MORBIHAN (L)
8 June 75	E2 137-10352	F	G	G	G	50		1906	OUESSANT (L)
21 June 75	E2 150-10060	F	F	F	F	40		2087	FLANDRES (L)
"	E2 150-10071	F	F	G	G	50		"	TOURAINE
"	E2 150-10074	G	G	G	G	(o) 30		"	GIRONDE (L)
"	E2 150-10080	F	F	G	G	10		"	ARCACHON (L)
"	E2 150-10083	G	G	G	G	10		"	GOLFE DE GASCOGNE (L)
22 June 75	E2 151-10135	F	F	F	G	20		2101	ARCACHON (L)
26 June 75	E2 155-10353	F	F	F	F	40		2157	MER CELTE (L)
9 July 75	E2 168-10073	G	G	G	G	50		2338	SAINTONGE
"	E2 168-10080	G	G	G	G	50		"	ARCACHON (L)
"	E2 168-10082	F	G	G	G	40		"	GOLFE DE GASCOGNE (L)
14 July 75	E2 173-10352	G	F	G	G	30		2408	OUESSANT (L)
27 July 75	E2 186-10071	G	G	G	G	0		2589	CHARENTE
"	E2 186-10073	G	F	G	G	10		"	ARCACHON (L)
"	E2 186-10080	G	G	G	G	40		"	COTE D'ARGENT (L)
28 July 75	E2 187-10111	F	P	G	X	30		2603	PAS-DE-CALAIS (L)
"	E2 187-10114	F	F	G	G	30		"	PICARDIE (L)
"	E2 187-10120	G	F	G	G	50		"	BAIE DE SEINE (L)
"	E2 187-10123	G	F	G	G	20		"	ANJOU
"	E2 187-10125	G	G	G	G	20		"	CHARENTE (L)
"	E2 187-10132	G	G	F	G	10		"	ARCACHON (L)
"	E2 187-10134	F	G	G	F	10		"	GOLFE DE GASCOGNE (L)
29 July 75	E2 188-10172	F	F	F	F	10		2617	MANCHE/BAIE DE SEINE (L
"	E2 188-10181	F	F	F	G	10	O	"	ESTUAIRE LOIRE (L)
"	E2 188-10183	F	G	F	F	0	O	"	VENDEE-CHARENTE (L)
"	E2 188-10190	F	F	F	G	0		"	LARGE DES LANDES
30 July 75	E2 189-10230	F	F	F	F	10		2631	N COTENTIN (L)
"	E2 189-10233	F	F	F	G	10		"	GOLFE ST MALO (L)
"	E2 189-10235	F	F	F	G	10		"	MORBIHAN (L)
"	E2 189-10242	F	F	F	F	10		"	GOLFE DE GASCOGNE
4 Sept.75	E2 225-10222	G	G	F	G	50		3133	ANGLETERRE/COTENTIN (L)
20 Sept.75	E2 241-10120	F	G	G	G	50		3356	CHARENTE/GIRONDE (L)
"	E2 241-10123	F	F	G	G	40		"	ARCACHON/LANDES (L)
"	E2 241-10125	F	F	F	F	30		"	ST JEAN DE LUZ (L)

DATE	PRODUCT ID	BLACK AND WHITE PRODUCTS MSS (Quality) 4	5	6	7	CLOUD COVER (%)	TAPE PRODUCT O=ordered ⊕=received	ORBIT NUMBER	CODE OF FRAMES (L = Littoral)
20 sept 75	E2 241-10125	F	F	F	F	30		3356	ST JEAN DE LUZ (L)
8 oct 75	E2 259-10110	F	F	G	G	20		3607	BAIE DE SEINE (L)
8 oct 75	E2 259-10113	-	G	G	F	50		"	ANJOU
25 oct 75	E2 276-10060	F	F	F	F	50		3844	DORDOGNE
28 oct 75	E2 279-10215	F	F	F	F	30		3886	COTENTIN NORD (L)
" " "	E2 279-10222	F	F	F	F	10		"	G. NORMAND-BRETON (L)
" " "	E2 279-10224	F	F	F	G	10		"	BRETAGNE SUD (L)
20 déc 75	E2 332-10165					0		4625	OLONNE (L)
" " "	E2 332-10171							"	LANDES (L)

PART 2 : FIRST PRELIMINARY REPORT ON LANDSAT 2

SPATIAL IMAGES INTERPRETATION : L'ARMORIQUE

I : TECHNIQUES

A - Photographic processing

We have generated black and white imagery products from negatives sent by Professor Verger, principal investigator. The chosen scale is 1 million.

B - Work procedure

B. 1. - Interpretation of the different avalaible spectral bands (on overlay), generally bands five and/or seven was carried out under a mirror stereoscope (Wild ST4), not to have a stereoscopic effect, but because it allows a binocular study ; we feel it is a good way to do the interpretation.

First of all we do the interpretation in using two similar spectral bands, for instance band five. Then we compare, always under a stereoscope, the results obtained on different spectral bands.

As far as possible, we also compare and complete the interpretation done on adjoining images, using the stereoscopic effect.

B. 2. - Identification of the Landsat image is obtained by reference to the 1 million scale topographical and geological maps of France, Unfortunatly on the later edition of the geological map coordinates are in grades out but this is a minor problem since images can generally be located at a glance.

Then, to obtain an accurate location of observed data we trace on the overlays all visible hydrographic detail.

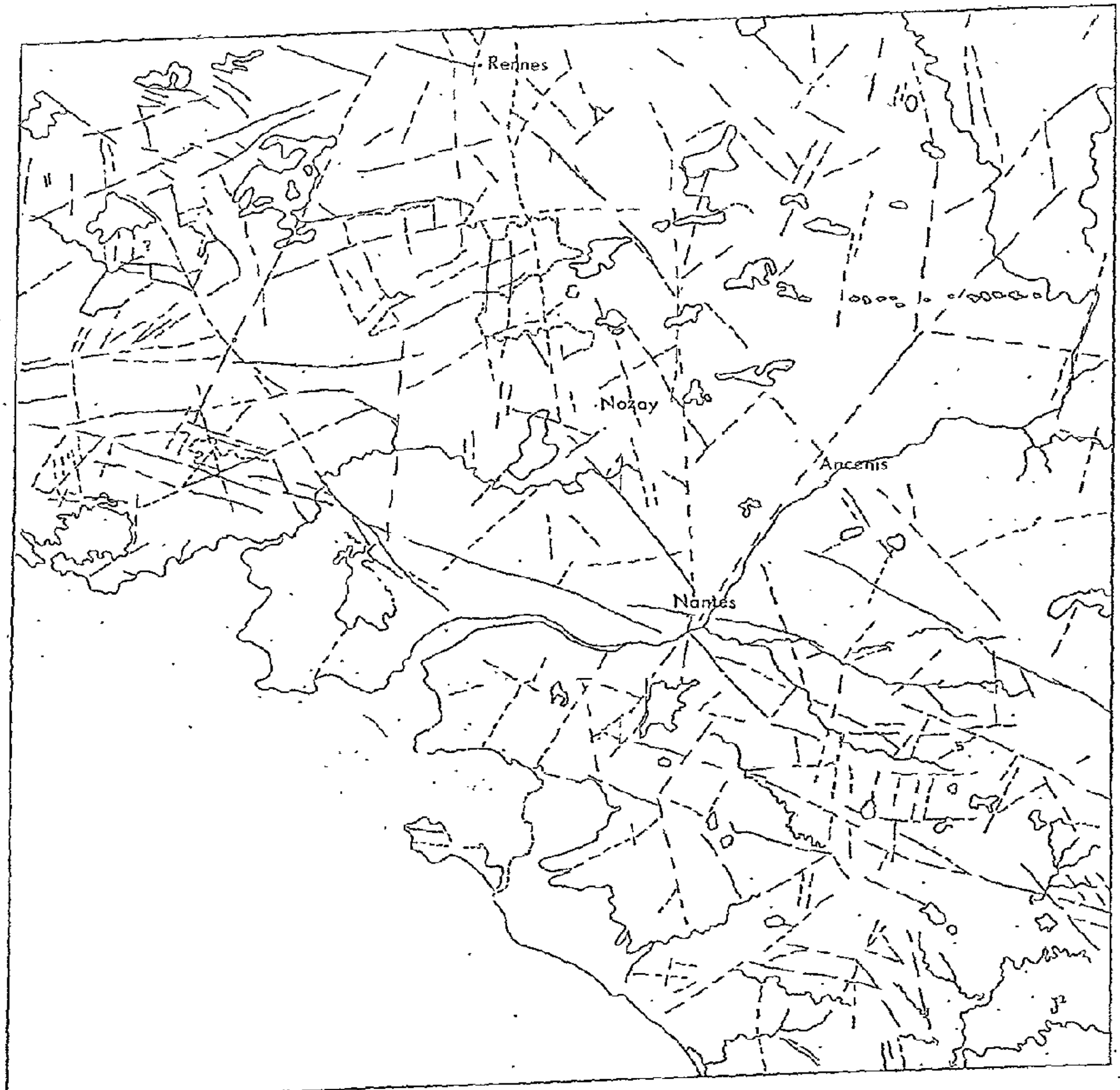
B. 3. - "Ground truth" techniques utilized mainly consist, in this first stage, in a search of avalaible scientific papers concerning proposed subjects and new data found in the area of interest. This point concerns, geology, geophysics, drilling, etc... as points of interest are raised interpretation and correlation, field geologists mapping the area at a 1/50 000 scale are advised.

II : ACCOMPLISHMENTS

The actual french atlantic coast is often a cloudy area and good quality images are not numerous. Nevertheless we have been able, using both Landsat 1 and 2 images, to investigate some of the problems we proposed to N.A.S.A. for investigation with space data.

ERTS 1 - IMAGE INTERPRETATION

SOUTH BRITANNY



Scale . 1/1.000.000

I.D Nº 1066-10294

Sept. 27.72 Mss Band 5

1 - Structural analysis

a - Boundaries between folded and not folded Cadomian area in central Armorique : this point is not yet investigated with the received documents because of the lack of complete coverage of the area.

b - Mapping of fractures is in progress in the process of being. The main lineament known in southern Armorique are visible well observed on ERTS 1 imagery. New directions of fracturing are also visible. (see fig.)

c - Some of the granitized axes known through ground mapping in the northern Armorique show very typical tone and pattern on Landsat 2 images and locally allow a differentiation between younger and ancient granites.

d - Several small sedimentary basins (Tertiary in age) exist in the " Massif Armoricain ". A first attempt to map them, between the towns of Rennes and Nantes, on Landsat images, was unsuccesful.

e - Extent of fracturing - The gravimetric map of France (1 million scale), recently published by B.R.G.M., geophysical department, reveals several extensions of the southern armorican lineament toward the south east, to the Massif Central. South of Nantes, gravimetric data cannot indicate which of the three observed geophysical discontinuities corresponds to the above mentioned lineament. A careful interpretation of four ERTS 1 and 2 images gives a preliminary answer to the question.

2 - Mineral exploration

a - Pb - Zn - Ba deposits.

Pb, Zn, Ba deposits are found, outside Massif Armoricain and Massif Central, in the sedimentary levels of the Poitou area. Three of them are important : Melle Alloue-Ambazac and Nontron-Chabrinas and this last one is located along a fault trending NW-SE, the main Armorican direction. Our purpose was to look for similar faults in Melle and Alloue-Ambazac, and to find similar directions which could direct new prospection. First results outline such faulting in Melle and Alloue-Ambazac, according to ERTS - 2 image interpretation. This faulting is parallel to the main armorican trends.

b - Sn deposits are located in or near Cadomian and Hercynian granite, along first order lineaments. Landsat 1 image show, near Nozay, one of the main deposits, why ore occurences are disappear eastward : an unknown north-south fault cuts the Sn bearing formation, disturbing the continuity of the deposit.

The problem of mineralized Cadomian granite - Hercynian sterile granite differenciation is on the way (see above).

c - Kaolin deposits.

Kaolin deposits are Known everywhere in the Armorique. We plan to test the ability of colour composite imagery to enhance . Cromalin process is to be used. The work is in progress in the northern part of Armorique.

3 - Ground water

We have proposed to survey water supply possibilities in two types of structure.

- The sandstone layers : their water bearing ability partly depends on their. The first results obtained in this domain confirm Landsat image mapping possibilities of fractures in this formation.

- Tertiary basins, where thick, could have important water bearing possibilities. We have seen they are not differenciated by tone on the ERTS images but, if they are linked with north-south fractures, as mentionned by Jaeger, the similar directions outlined by space data are promissing to direct future water supply research.

4 - Other results

Circular structures detected in the vicinity of Limoges on Landsat 1 image (Structural investigation in the Massif Central using ERTS - 1 multispectral imagery - N.A.S.A. report 1974) are also visible on ERTS - 2 images (2186 - 10071 - July 1975). We would like to point out specially the Rochechouart meteorite, this new image confirming its possible southern extend and its general shape, as visible on ERTS - 1 image and mapped on the field.

III : SIGNIFICANT RESULTS

The main results concern :

- The extent of the armorican southern lineament toward the south east until Montalembert where north 20 faulting disrupts it. On a global tectonic point of view this is a significant result.

- The existence of armorican fractures directions near the Melle and Alloue-Ambazac Pb, Zn, Ba deposits, new data confirming genesis hypothesis.

- The discovery of similar other possible faults which can be a guide for further Pb-Zn prospection in the Poitou area.

IV : PUBLICATIONS

No publications are in progress on these first results but since the B.R.G.M. prepared the final N.A.S.A. report (ERTS - 1) on the Massif Central some papers were published, using ERTS - 1 image interpretation results. They concern :

M. LAMBERT - La structure impactitique de Rochechouart (Limousin) et du contexte regional par interprétation des photos-satellites ERTS. Bull. B.R.G.M., section 1, n° 4, 1974.

J.-M. BROSSE - Apport de la télédétection en géologie structurale (Massif Central - France)
Thèse Orléans et Bull. B.R.G.M., 2è série, Section II, n° 6, 1975.

N. DEBEGLIA, A. GERARD - Apport de l'aéromagnétisme à l'étude du Massif Central français.
Bull. B.R.G.M., section II, n° 4, 1975.

J.-Y. SCANVIC - Apport de l'imagerie spatiale multi-spectrale à la compréhension tectonique du Massif Central français et de son environnement sédimentaire.
Bull. B.R.G.M., section II, n° 4, 1975.

V : DATA QUALITY

- Bande 7 is often unusable along the sea side (very pale), by contrast.

- On some scenes, for instance 2186 - 10071 - 27 July 1975, covering both sedimentary and basement formations, while the sedimentary area is a very good quality image the basement area is generally too dark to be well interpreted.

VI : CONCLUSIONS

Having used Landsat 1 imagery to investigate tectonic features we can, assume it is a useful complementary tool : comparison between Landsat tectonic interpretation and geophysical, air photographs and ground data seems to be the right method to improve our global knowledge. First Landsat 2 results in the tectonic domain confirm this idea. Practical applications of the method is in progress :

- Establish a sismo-tectonic map of France, to select power station sites.

- Characterize the location of ore deposits.

- Complete photogeological studies realized as a preparation for geological mapping of France at a 1/50 000.

The technical impact of this new data source on the B.R.G.M. activities is evident : engineering geologists, mining geologists and mapping geologists ask for ERTS interpretation and have already found in the field some evidence of its practical interest.